Innovative technologies and tools to increase deployment of domestic heat pumps in the UK

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UK heat pump landscape

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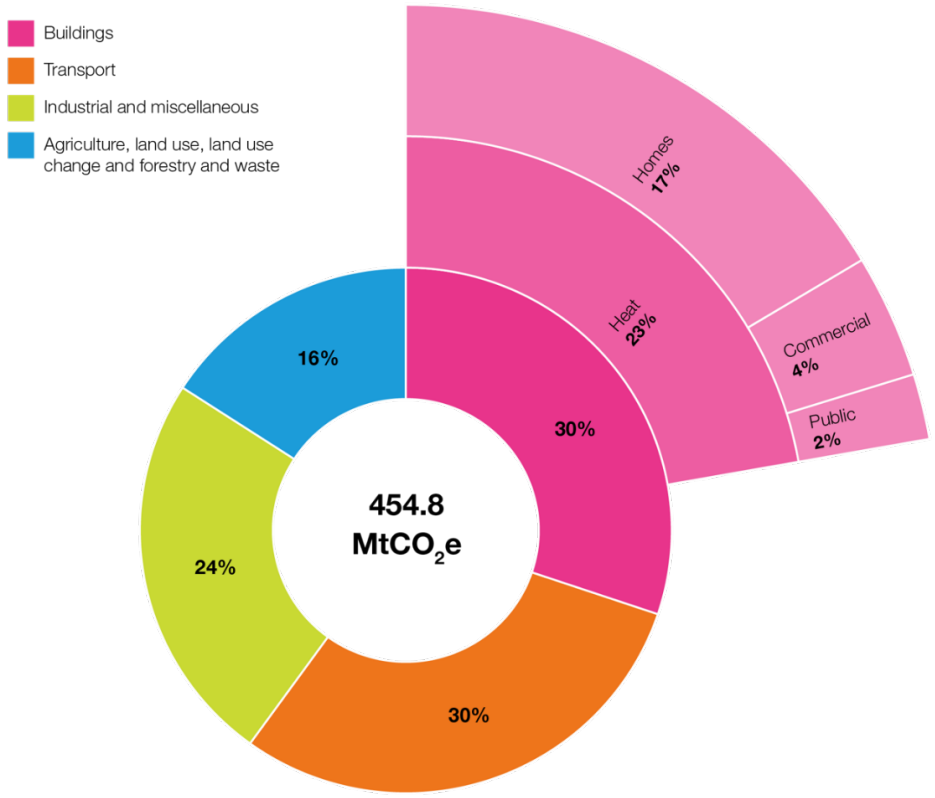
- The UK government has a legally binding-target to achieve **net-zero** greenhouse gas emissions by 2050.
- Heating buildings accounts for around **23 per cent** of all UK greenhouse gas emissions.
- To meet Net Zero, we need to decarbonise virtually **all of our building stock**
- This means converting around **30 million buildings** to low carbon heating by 2050



UK Policy Context for Heat Pumps

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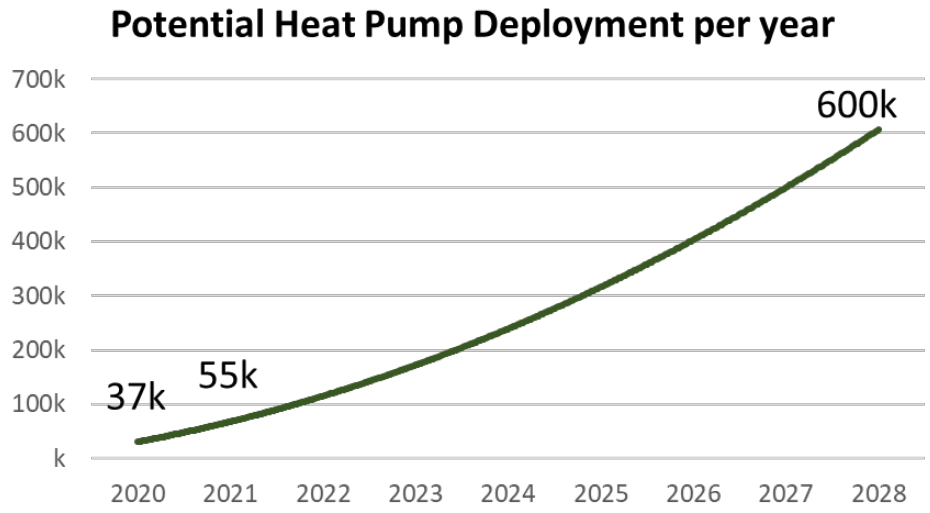
- Heat pumps have a major role in **all pathways to net zero**.
- **To stay on track to meet net zero,** we need to ensure deployment of heat pumps reaches **at least 600,000 installations per year by 2028**.
- If limited low-carbon hydrogen is used for heating, we would need to further grow the heat pump market to install **at least 1.5 million heat pumps per year by the mid-2030s.**
- In a high hydrogen scenario, heat pump deployment will continue at 600k p.a. post 2028.



Heat Pump Ready Programme

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The Heat Pump Ready programme (HPR) forms part of the UK Governments £1bn Net Zero Innovation Portfolio (NZIP) under the Built Innovation theme.

Heat Pump Ready provides up to £60m of funding to projects supporting the aims of:

Reduce lifetime costs

Develop approaches to **engage with homeowners** and other key players

Inform future heat pump **policy and regulation**

Stimulate solutions to mitigate the impact of domestic heat pumps on the electricity system

Strengthen partnerships within the UK's heat pump sector

Improve the consumer experience

Heat Pump Ready Development

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- Rapid Evidence Assessment (REA)

1. **Financial Innovations:** What are the necessary financial innovations required to deliver a large-scale roll-out of heat pumps in the United Kingdom (UK)?
2. **Low Voltage Grid Issues:** What are the Low Voltage (LV) grid issues associated with a concentrated deployment of heat pumps and how can we mitigate these? What is the necessary size of a heat pump cluster to achieve appropriate grid impact learnings?
3. **Roll-out Facilitation:** What are the necessary innovations or learnings required to facilitate the large-scale roll-out of heat pumps? What tools or established processes of stakeholder coordination exist that could support the effective roll-out of heat pumps and are there examples of coordinated deployment?
4. **Performance and Deployment:** What are the technological improvements to the heat pump system and tools that could be developed to support any of the above aims - i.e. the large-scale deployment of heat pumps in the UK?

REA Findings

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1. Research on business models needed to stimulate update of domestic heat pumps.
2. Network issues can be expected at low voltage levels due to increase in heat pump deployment
3. Evidence that there is a benefit to effective coordination between stakeholder groups and a understanding that a consumer-focused framework may lead to increased take up of heat pumps.
4. Understanding that innovation is required to bring actual performance of heat pumps closer to project performance

1. Trailing of business models in-situ and at scale to increase consumer understanding and motivations.
2. Limited amount of field data, at large scale, with electricity grid impact learnings expected at ~20% penetration of heat pumps in dwellings.
3. Understanding of the role of effective and accurate energy modelling and consumer satisfaction.
4. Develop innovation to support design improvements, manufacturing, installation and monitoring, maintenance and operation of heat pumps.

Heat Pump Ready Objectives

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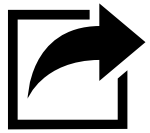
1) Develop innovative coordinated methodologies to achieve high-density heat pump deployment

2) Support innovative tools and technologies which overcome barriers to heat pump deployment



3) Foster collaboration and learning across the Heat Pump Ready programme and wide heat pump and associated sectors

Innovative Tools & Technologies Objectives

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REA identified the following widespread key barriers to large-scale heat pump deployment:

- Affordability: the high cost of heat pumps
- Lack of availability: lack of a strong market presence
- Lack of awareness: of systems and benefits by households and the industry
- Acceptance: heat pumps are perceived to be harder to install and use than gas boilers
- Consumer willingness: resistance against potential disruption during installations
- Consumer behaviour: demanding and using heat as if it were being produced by a fossil fuel boiler
- Long-term demand: lack of certainty required for investors and businesses

HPR providing up to £15m of funding to support innovation in 5 main categories:

1. Increasing the performance whilst reducing the cost of domestic heat pumps
2. Minimising home disruption whilst providing high quality installations
3. Providing financial solutions for heat pumps
4. Improving the consumer journey through the transition to heat pumps
5. Creating a smart and flexible home energy system

Funded Projects

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- 24 projects were successful in receiving funding through Heat Pump Ready.
- Projects are of varying duration, with all projects due to complete by March 2025
- 3 to 6 projects have been funded under each category

The Consumer Journey of Projects

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0. Development of heat pump technologies

Manufacturing

ventive

icax INTERSEASONAL HEAT TRANSFER

Increased Suitability

R.J. BARWICK Net Zero Carbon Buildings

TCS

1. Finding an installer & obtaining quotes

MCS

VIA ANALYTICS

2. Heat pump system design

BUILD TEST SOLUTIONS

EDF ENERGY

q-bot

geo smarter energy

heatly

hildebrand

HOARE LEA

3. Financing the heat pump system

CITY SCIENCE endless possibilities

GREEN HOMEOWNER LOAN powered by Home Infrastructure Technology Ltd

EnergieSprong

parity projects

4. Heat pump operation and controls

Mixergy

wondrwall

Kensa Heat Pumps A KENSA GROUP COMPANY

switchee

5. Maintenance of the heat pump system

guru

How can heat pumps be correctly sized?

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Project: MEASURED - The role of measured building performance in heat pump specification, system design and management

BUILD TEST SOLUTIONS

elmhurst energy CONSULTANCY

Veritherm

Problem: The current process for heat pump specification is largely based around estimations of the physical characteristics of the property and relies on certain assumptions and the experience of the assessor.

Solution:

- Creation of a new method to optimise heat pump specification, design and management by using onsite measurements of building performance parameters and design inputs.
- Utilising smart meters, low cost sensors, and newly established techniques to establish home specific key performance parameters which fed into heat pump design and specification to ensure the heat pump is accurately designed for the home.

Outcome:

- Publicly available protocol that defined the measurement options and standards that must be followed when calculating a heat transfer coefficients (HTC)
- Reduced risk of heat pump oversizing which would lead to increased up-front capital costs and on-going costs to the consumer, in addition to limiting consumer disruption.

Funding: £233,888

How to reduce upfront capital costs to consumers?

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Project: Performance

parity projects | London South Bank University | icax INTERSEASONAL HEAT TRANSFER | Cambridge Energy | RETROFITWORKS BUILDING EFFICIENCY TOGETHER

Problem: The capital costs of installing a heat pump system and the supporting retrofit improvements are high and can be unexpected. Traditional loans can have high interest rates, and payback mechanisms are not designed to take into account savings made through improved building performance.

Solution:

- Ability to accurately predict future energy use in dwellings once energy efficiency measures and heat pump have been installed
- Create low-cost, cost-effective options analysis and verification protocol to enable the offer of financially insurable performance guarantee to homeowners and landlords.

Outcome:

- Creation of software that successfully improve assurance of energy efficiency retrofits.
- Reduce the financial burden to homeowners as well as supporting financial institutions' ability to lend by helping them to manage their financial risk and offer lending at more preferable rates to homeowners

Funding: £670,708

Can heat pumps enable electricity network load shifting?

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Project: Highly Flexible Storage Heat Pump (HPSHP)

Kensa Heat Pumps – A KENSA GROUP COMPANY | mtc Manufacturing Technology Centre | PNDC University of Strathclyde

Problem: There have been iterative improvements to heat pump technology since James Harrison patented the highly successful refrigeration circuit design in 1856. Now, peaks in electrical demand from many users plugging in a variety of technologies at the same time, including electrical heating, is causing stress on the electricity grid, requiring a step change in heat pump technology.

Solution:

- A combined electrically-driven heat pump with heat storing batteries utilising phase change material.
- Ability to shift heat production (heat battery charging) away from times of peak electricity demand from the grid

Outcome:

- Remove the need for consumers to find space for a separate hot water cylinder.
- Consumers will be able to store lower cost and lower carbon heat in anticipation of their peak demand period.
- Provide increased flexibility and efficiency at reduced running costs at a cost neutral price point at purchase (compared to conventional ground source heat pumps).

Funding: £1,233,117

Questions?

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Further project summaries:
https://www.heatpumpready.org.uk/projects/

Email: heatinnovation@beis.gov.uk

Website: www.heatpumpready.org.uk